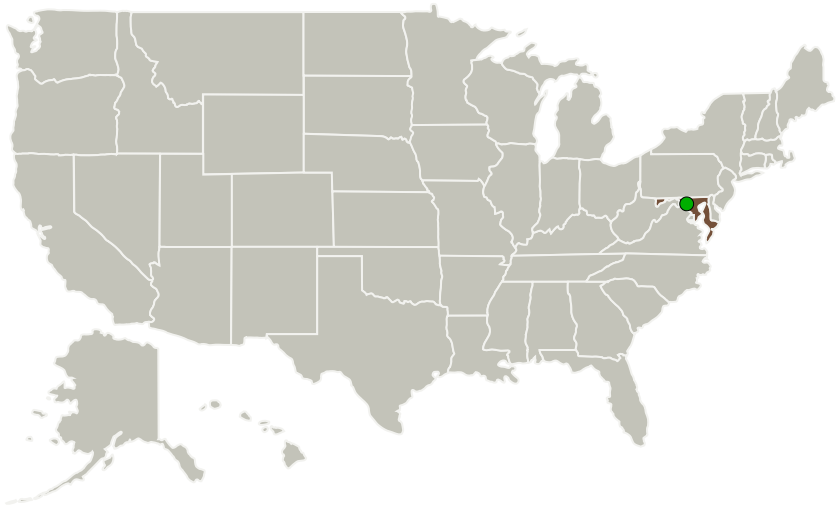
A New Class of Flare Prediction Algorithms: A Synthesis of Data, Pattern Recognition Algorithms, and First Principles Magnetohydrodynamics, Phase I

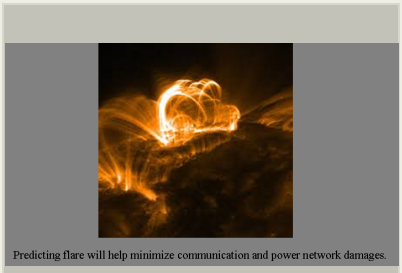
Completed Technology Project (2014 - 2014)

Project Introduction

Researchers have been working on flare prediction for many decades. However, the best prediction result achieved by Falconer et al. for major flares, CMEs, and solar proton events (SPEs) is a probability of detection of 39%, meaning that only 39% of the events are correctly predicted. Existing flare prediction algorithms are mainly based on a combination of data, statistical analysis, and pattern recognition algorithms. A serious deficiency of these algorithms is that they do not include the constraints and predictive power of the basic equations of magnetohydrodynamics (MHD) that describe the dynamics of the plasma atmosphere. We propose a new approach to flare prediction based on combining a detailed data based description of the solar atmosphere with the equations of magnetohydrodynamics (MHD). In this approach, a subset of the MHD equations take data as input, and then predict physical quantities that are not measured but may be important for predicting flares. Since the MHD equations must be obeyed by the plasma, when combined with data they also provide new constraints on pattern recognition algorithms that search for correlations between the occurrence of a flare and the values of observed and MHD model predicted quantities that describe the pre-flare plasma.

Primary U.S. Work Locations and Key Partners





A New Class of Flare Prediction Algorithms: A Synthesis of Data, Pattern Recognition Algorithms, and First Principles Magnetohydrodynamics Project Image

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Organizations Performing Work	Role	Type	Location
Applied Research, LLC	Lead Organization	Industry Minority-Owned Business	Rockville, Maryland
Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations
Maryland

Project Transitions

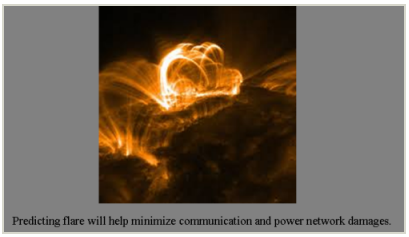
June 2014: Project Start

December 2014: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/137707)*

Images



Project Image
A New Class of Flare Prediction Algorithms: A Synthesis of Data, Pattern Recognition Algorithms, and First Principles Magnetohydrodynamics Project Image
(https://techport.nasa.gov/image/135737)

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
Applied Research, LLC

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

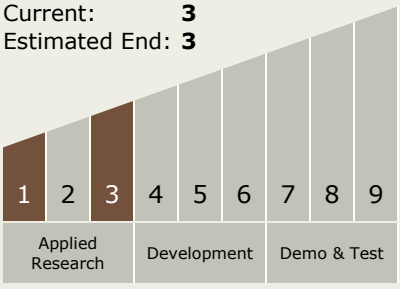
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Huamei Chen

Technology Maturity (TRL)

Start: **1**
Current: **3**
Estimated End: **3**



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Technology Areas

Primary:

- TX11 Software, Modeling, Simulation, and Information Processing
  - TX11.2 Modeling
    - TX11.2.4 Science Modeling

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System